

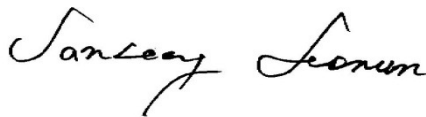
TO : IT Solution
DATE : Aug. 30, 2011

SAMSUNG TFT-LCD

MODEL NO. : LTN140AT26-8

NOTE : Extension code [-8]
→ LTN140AT26-8
Surface type [**Anti-Glare**]

Any modification of Spec is not allowed without SEC's permission
The information described in this SPEC is preliminary and can be changed without prior notice.



APPROVED BY : _____

PREPARED BY : **Jonathan KANG** _____

Application Engineering Group
Samsung Electronics Co., Ltd.

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REVISION HISTORY

Approval

Date	Revision No.	Page	Summary
Aug, 30, 2011	A00	All	The specification of LTN140AT26-8 model was issued first.

CODE REVISION HISTORY

Date	Model.	Revision No.	Summary	MP or EOL
Aug,30,2011	LTN140AT26-8	803	Basic model	

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GENERAL DESCRIPTION

DESCRIPTION

LTN140AT26 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 14.0" contains 1366 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the optimum viewing angle.

FEATURES

- High contrast ratio
- HD (1366 x 768 pixels) resolution
- Low power consumption
- Fast response time
- LED Back Light with embedded LED Driver
- DE (Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- Green product (RoHS compliant)

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

GENERAL INFORMATION

Item	Specification	Unit	Note
Display area	309.399(H) x 173.952(V) (14.0" HD diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1366 x 768	pixel	16:9
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.2265(H) x 0.2265(V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	Haze 25, Hard-Coating 3H		Anti-Glare

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Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	323.0	323.5	324.0	mm	
	Vertical (V)	191.5	192.0	192.5	mm	
	Depth (D)	-	-	5.2	mm	(1)
Weight		-	-	350	g	

Note (1) Measurement condition of outline dimension

. Equipment : Bernier Calipers

. Push Force : 750g · f (minimum)

1. ABSOLUTE MAXIMUM RATINGS

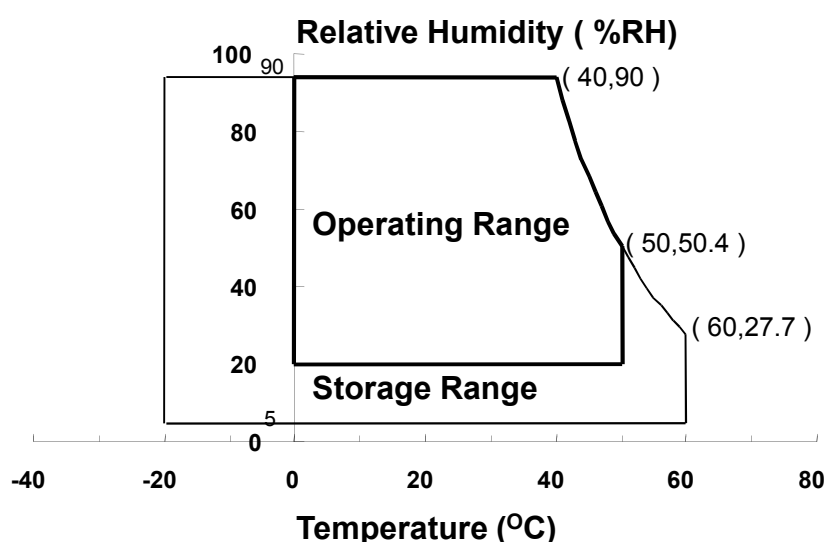
1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate	TSTG	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	TOPR	0	50	°C	(1)
Shock (non-operating)	Snop	-	240	G	(2),(4)
Vibration (non-operating)	Vnop	-	2.41	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.

95 % RH Max. ($40^{\circ}\text{C} \geq T_a$)

Maximum wet - bulb temperature at 39°C or less. ($T_a > 40^{\circ}\text{C}$) No condensation



(2) 2ms, half sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$.

(3) 5 - 500 Hz, random vibration, 30min for X, Y, Z.

(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

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1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

 $V_{DD} = 3.3V, V_{SS} = GND = 0V$

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)
Logic Input Voltage	V_{IN}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)

Note (1) Within T_a ($25 \pm 2^\circ C$)

(2) BACK-LIGHT UNIT

 $T_a = 25 \pm 2^\circ C$, Duty = 100%

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Current	I_L	-	25	-	mA	(1)
LED Voltage	F_L	3.0	3.2	3.4	V	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded
Functional operation should be restricted to the conditions described under normal operating conditions.

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2. OPTICAL CHARACTERISTICS

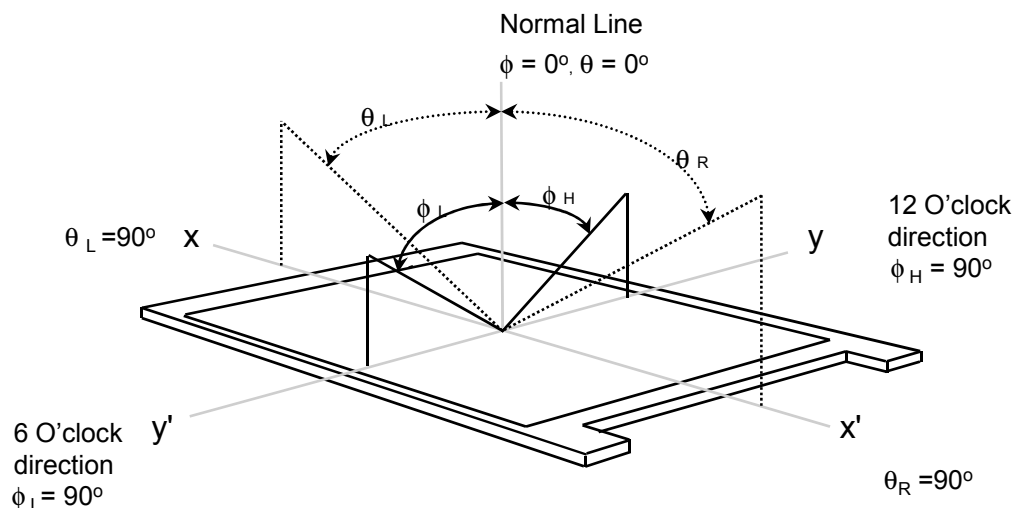
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON SR-3

* Ta = 25 ± 2 °C, V_{DD}=3.3V, fv= 60Hz, f_{DCLK} = 72.33MHz, IF = 25 mA

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio (5 Points)		CR	Normal Viewing Angle $\phi = 0$ $\theta = 0$	300	-	-	-	(1), (2), (5)
Response Time at Ta (Rising + Falling)		T _{RT}		-	16	25	msec	(1), (3)
Average Luminance of White (5 Points)		Y _{L,AVE}		200	220	-	cd/m ²	IF=25mA (1), (4)
Color Chromaticity (CIE)	Red	R _x		-0.03	0.585	+0.03	-	(1), (5) SR-3
		R _y			0.355			
	Green	G _x			0.350			
		G _y			0.580			
	Blue	B _x			0.165			
		B _y			0.125			
	White	W _x			0.313			
		W _y	0.329					
Color Gamut				45	-	%		
Viewing Angle	Hor.	θ_L	CR ≥ 10 At center	40	-	-	Degrees	(1), (5) SR-3
		θ_H		40	-	-		
	Ver.	ϕ_H		15	-	-		
		ϕ_L		30	-	-		
13 Points White Variation		δ_L		-	-	1.7	-	(6)

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Note 1) Definition of Viewing Angle : Viewing angle range($10 \leq C/R$)

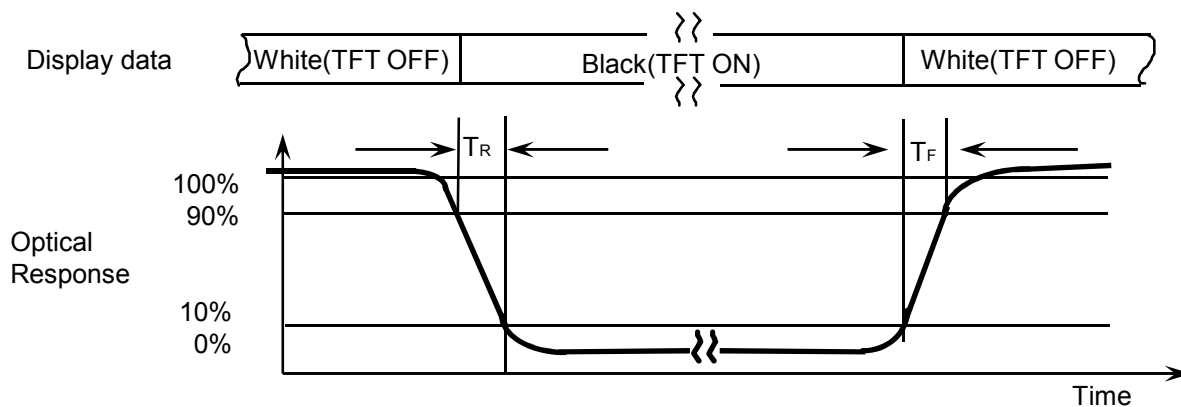


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

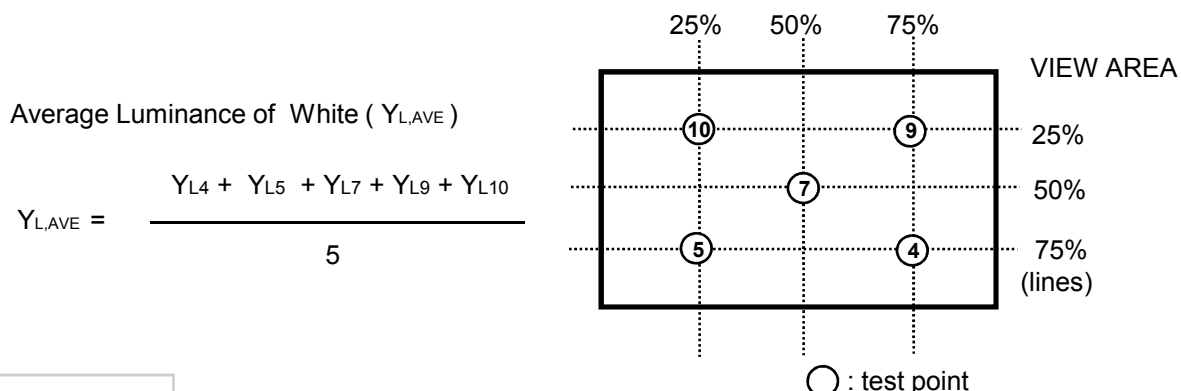
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : (4) , (5) , (7) , (9) , (10) at the figure of Note (6).

Note 3) Definition of Response time :



Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

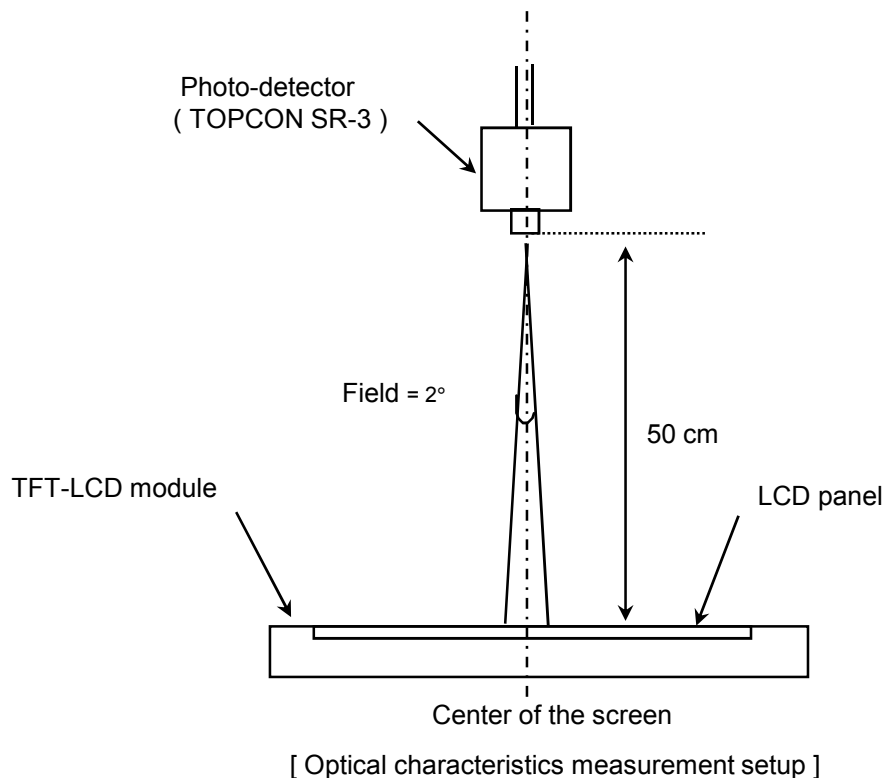


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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.

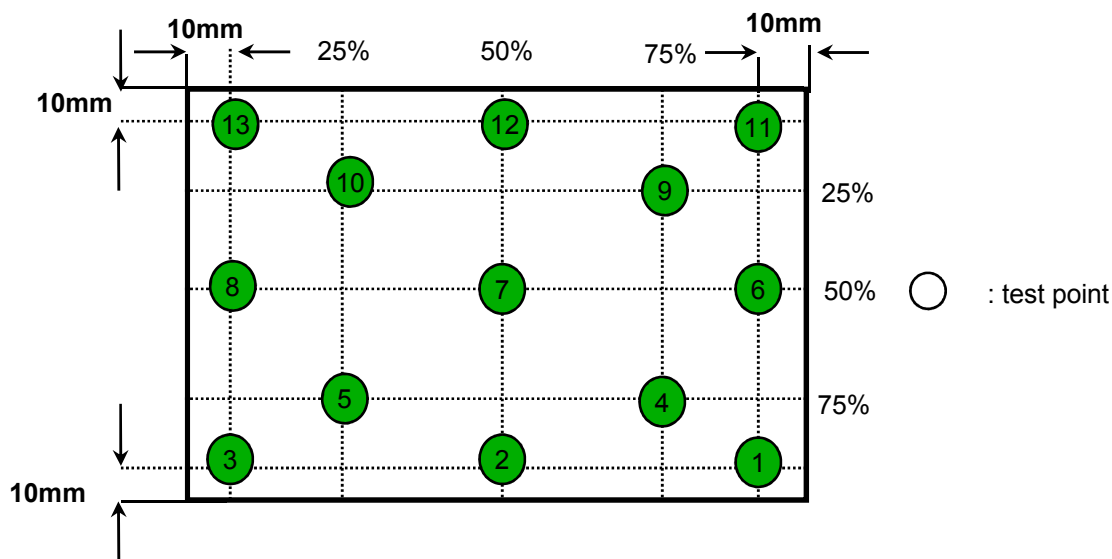
IF current : 25 mA

Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Note 6) Definition of 13 points white variation (δL), CR variation(C_{VER}) [① ~ ⑬]

$$\delta L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



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3. ELECTRICAL CHARACTERISTICS

Approval

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

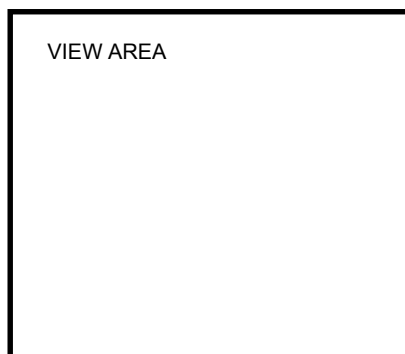
Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	3.0	3.3	3.6	V	
Differential Input Voltage for LVDS Receiver Threshold	High	V _{IH}	-	-	+100	mV	V _{CM} = +1.2V
	Low	V _{IL}	-100	-	-	mV	
Vsync Frequency		f _v	-	60	-	Hz	
Main Frequency		f _{DCLK}	-	72.33	85	MHz	
Rush Current		I _{RUSH}	-	-	1.5	A	(4)
Current of Power Supply	White	I _{DD}	-	210	-	mA	(2),(3)*a
	Mosaic		-	210	240	mA	(2),(3)*b
	V. stripe		-	335	350	mA	(2),(3)*c

Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

(2) f_v = 60Hz, f_{DCLK} = 72.33MHZ, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern

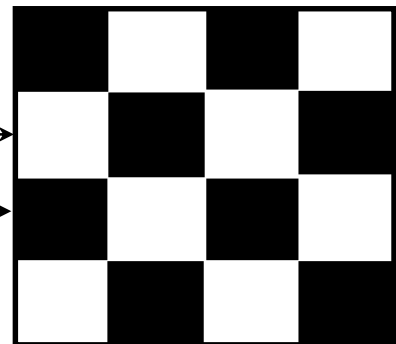
*a) White Pattern



*b) Mosaic Pattern

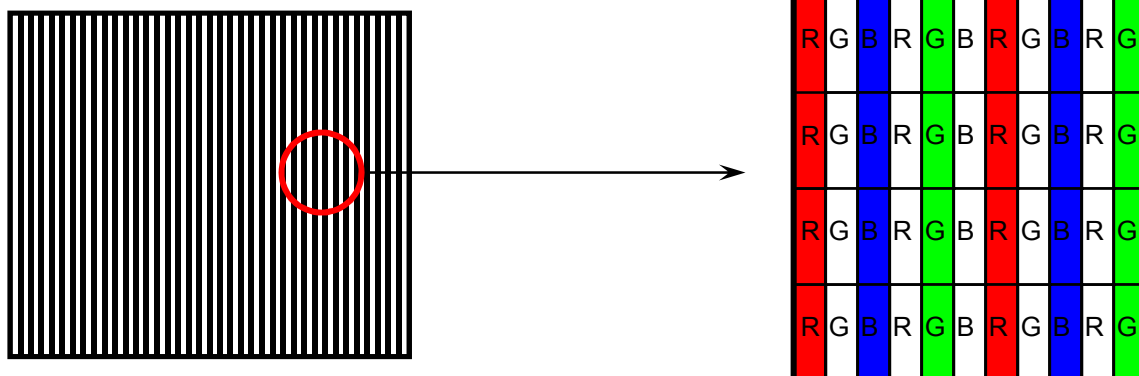
Display Brightest Gray Level →

Display Darkest Gray Level →

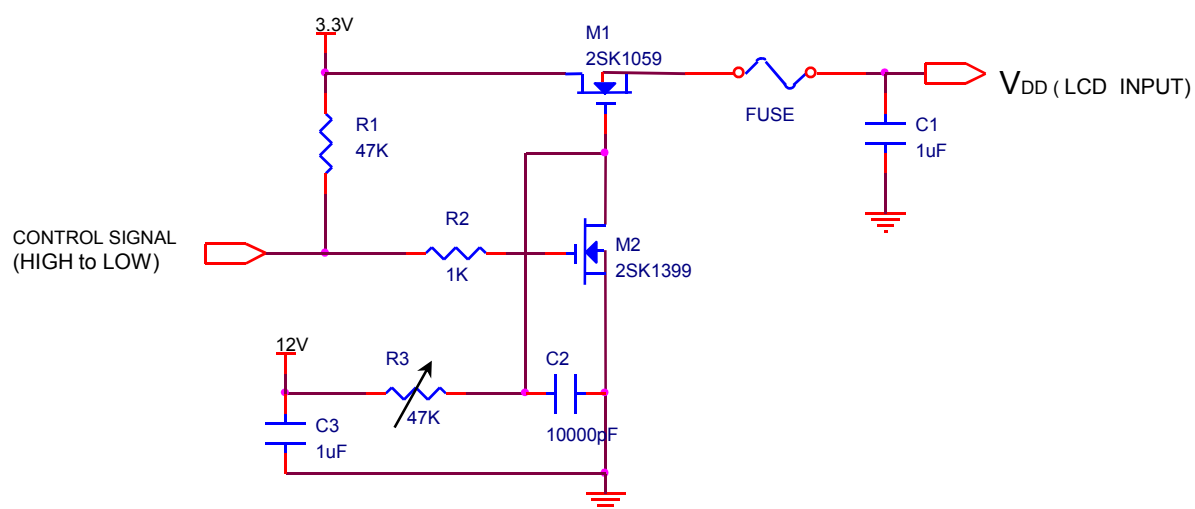


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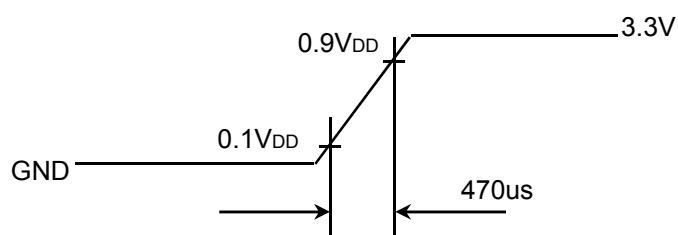
*c) 1dot Vertical stripe pattern



4) Rush current measurement condition



V_{DD} rising time is 470us



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3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	IF		275		mA	
LED Forward Voltage	VF	3.0	3.2	3.4	V	
LED Array Voltage	VP	-	32	-	V	VF X 10LEDs
Operating Life Time	Hr	12,000	-	-	Hour	(1)

Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and IF = 27 mArms until one of the following event occurs.

1. When the brightness becomes 50% or lower than the original.

3.3 LED Driver

Ta= 25 ± 2 °C

Item-	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V _{in}	7	12	20	V	-
Input Current	I	-	25	-	mA	-
EN control level	ON	2	-	-	V	
	OFF	-	-	0.8	V	
PWM control level	ON	2	-	-	V	
	OFF	-	-	0.8	V	
PWM Control Duty Ratio	D	10	-	100	%	
External PWM Dimming Control Frequency (BLIM)	F _{BLIM}	-	1	10	kHz	

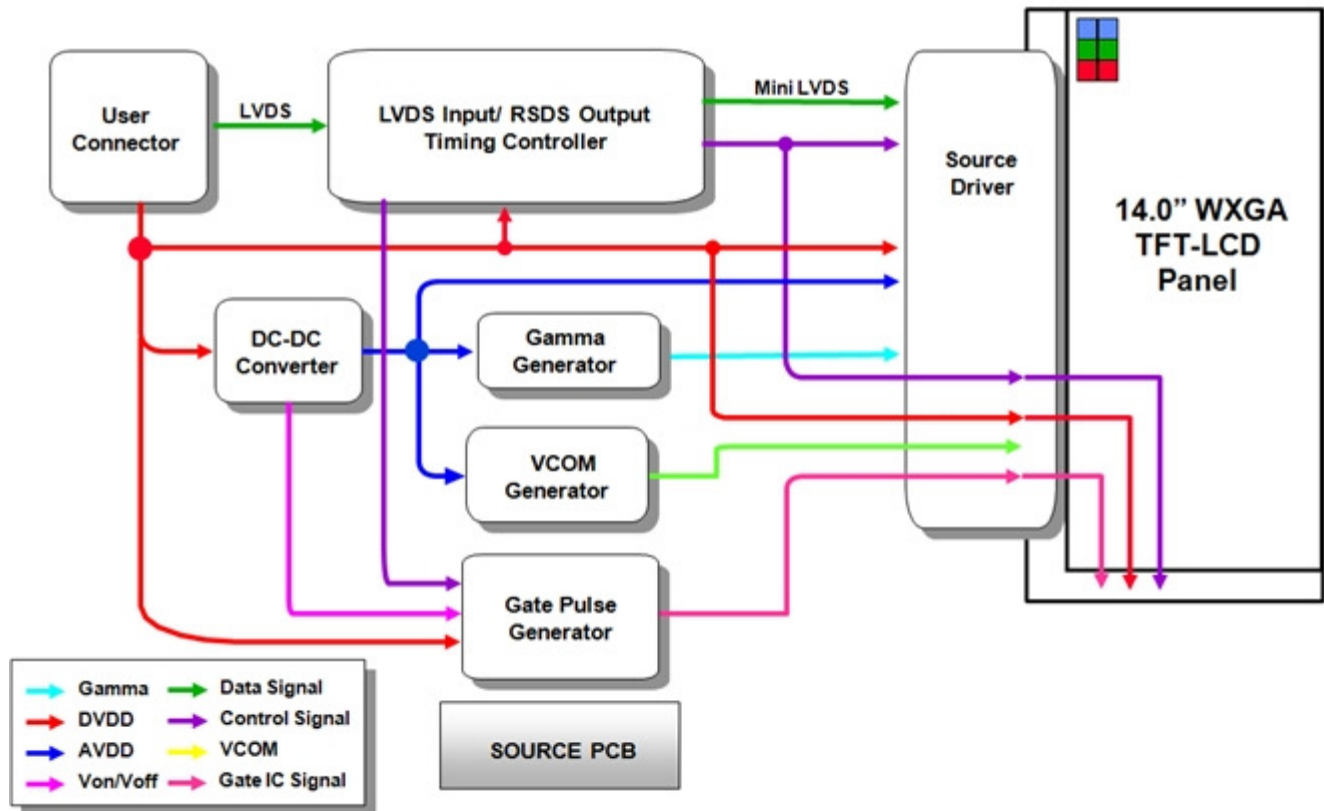
Note (1) Test Equipment : Fluke 45

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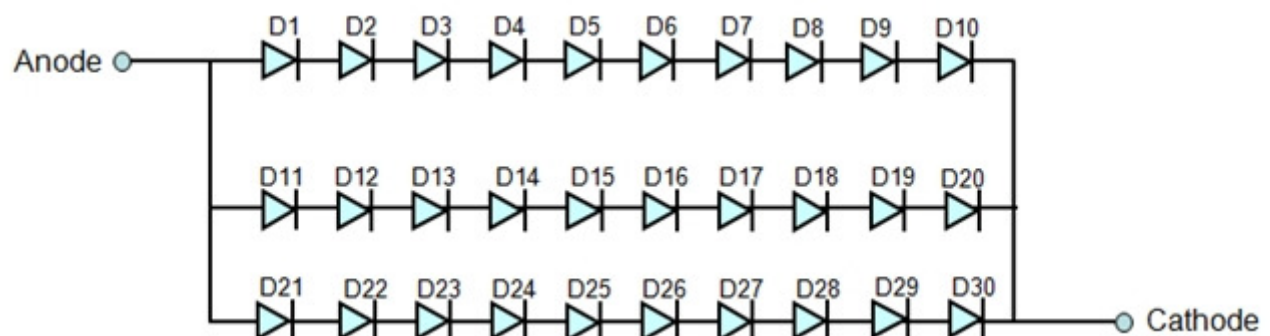
4. BLOCK DIAGRAM

4.1 TFT LCD Module

LTN140AT26-8 Circuit Block Diagram



4.2 LED connection and placement



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5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : 20455-040E-0 by I-PEX or equivalent)

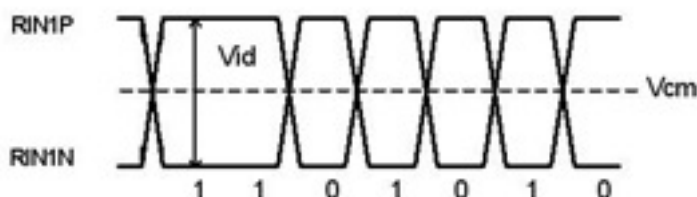
No.	Signal	Description
1	NC	No Connection
2~3	AVDD	Power Supply, 3.3V (typical)
4	DVDD	DDC 3.3V power
5	NC	No Connection
6	SCL	DDC Clock
7	SDA	DDC Data
8	Rin0-	-LVDS differential data input (R0-R5, G0)
9	Rin0+	+LVDS differential data input (R0-R5, G0)
10	GND	Ground
11	Rin1-	-LVDS differential data input (G1-G5, B0-B1)
12	Rin1+	+LVDS differential data input (G1-G5, B0-B1)
13	GND	Ground
14	Rin2-	-LVDS differential data input (B2-B5, HS, VS, DE)
15	Rin2+	+LVDS differential data input (B2-B5, HS, VS, DE)
16	GND	Ground
17	ClkIN-	-LVDS differential clock input
18	ClkIN+	+LVDS differential clock input
19	GND	Ground
20~21	NC	No Connection
22	GND	Ground
23~24	NC	No Connection
25	GND	Ground
26~27	NC	No Connection
28	GND	Ground
29~30	NC	No Connection
31~33	VBL-	LED Ground
34	NC	No Connection
35	BLIM	PWM for luminance control (200~1KHz, 3.3V, 10~100%)
36	BL_Enable	BL On/Off (On:2.0~3.3V, Off: 0~0.5V)
37	NC	No Connection
38~40	VBL+	LED Power Supply 5.5V~20V

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5.2 LVDS Interface

5.2.1 LVDS DC Input

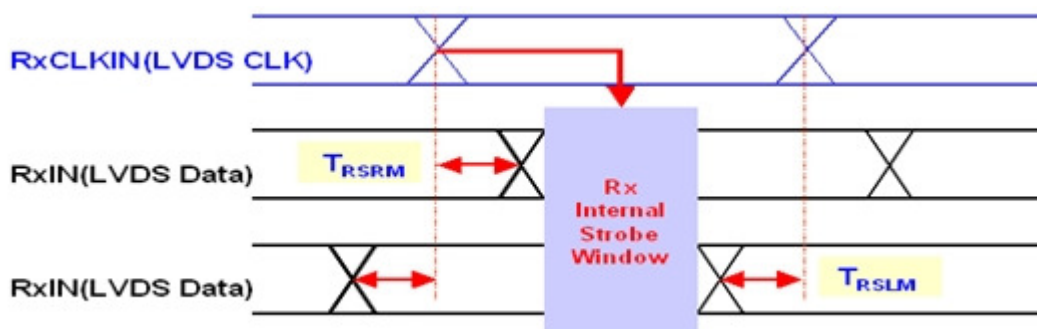
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS Differential Voltage	V _{id}	200	200	400	mV	
Input Common Mode Voltage	V _{CM}	0.4	1.2	1.6	V	



5.2.2 LVDS AC Input

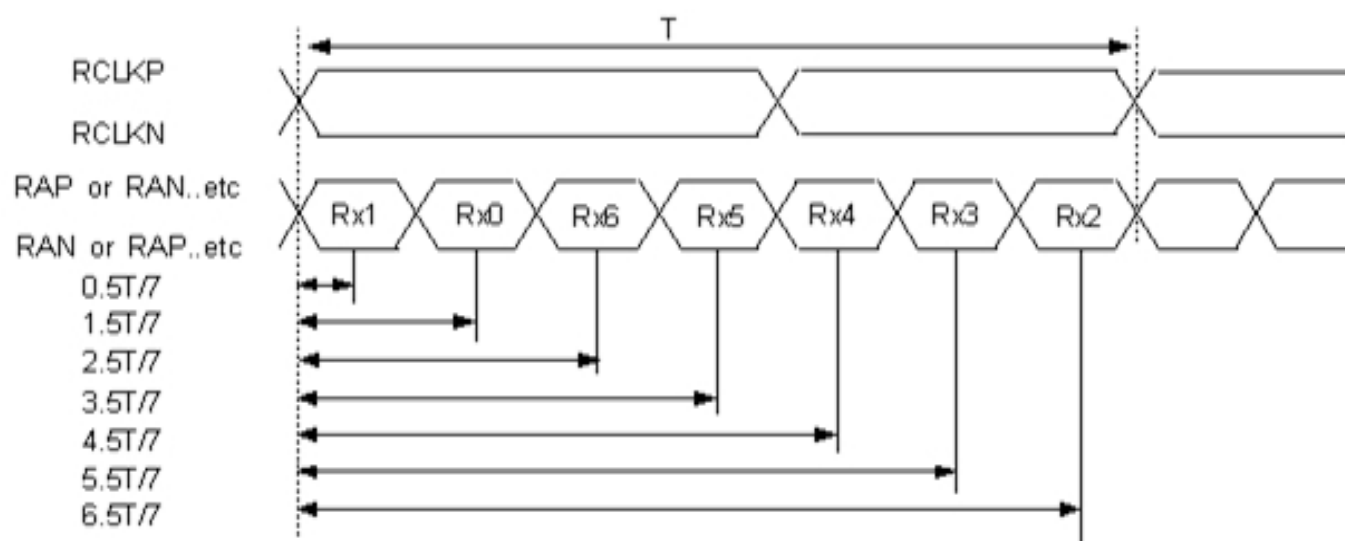
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
PLL Lock Time			-	-	20	μsec	
LVDS Clock Ratio		T _{OD}	45	50	55	%	
LVDS RX Skew (Strobe) Right Margin	85MHz	T _{RSRM}	400	-	400	ps	(1),(2)
	50MHz		600	-	600	ps	(1),(2)
LVDS RX Skew (Strobe) Left Margin	85MHz	T _{RSLM}	400	-	400	ps	(1),(2)
	50MHz		600	-	600	ps	(1),(2)
SSC Modulation Rate			±0.05	-	±3	%	(3)
SSC Modulation Frequency			30	200	300	KHz	(3)

Note (1) : LVDS Receiver Skew (Strobe) Margin

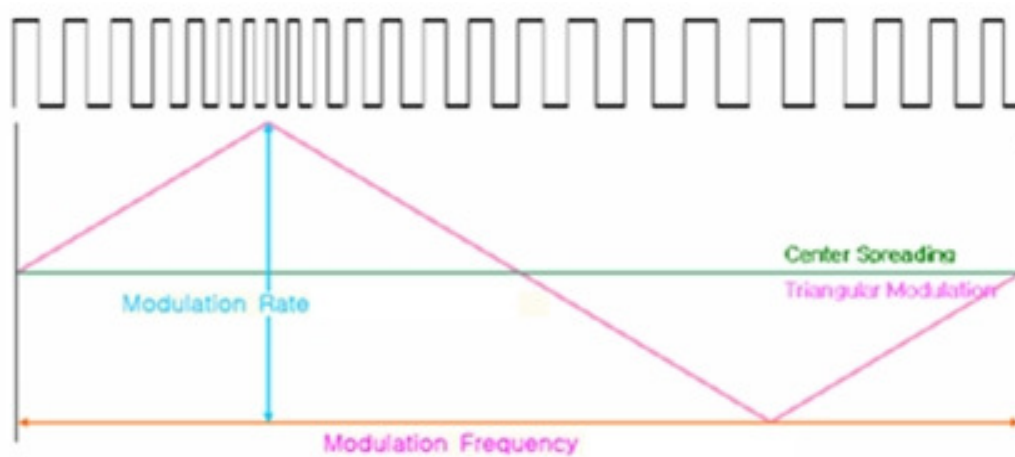


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Note (2) : Ideal Strobe Positions for LVDS Input



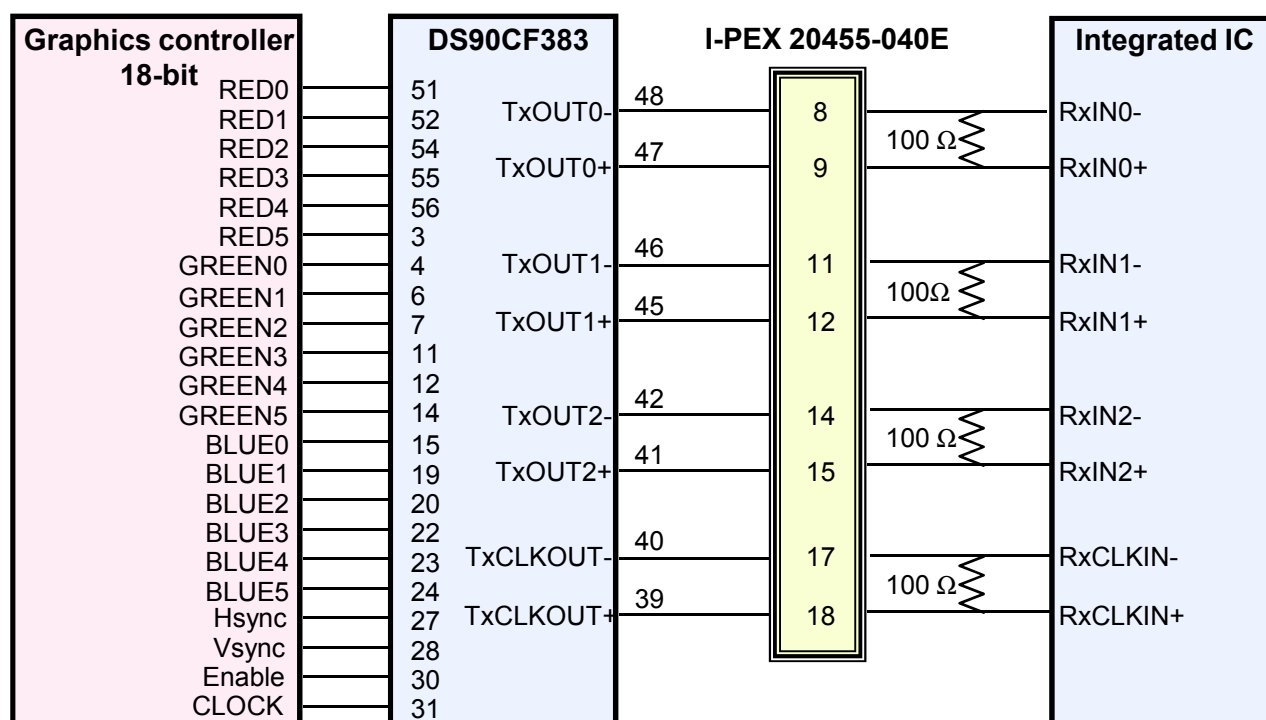
Note (3) : SSC (Spread Spectrum Clock)



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5.2 LVDS Interface : Transmitter SN75LVDS86 or Compatible

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
51	TxIN0	R0	14	TxIN14	G5
52	TxIN1	R1	15	TxIN15	B0
54	TxIN2	R2	19	TxIN18	B1
55	TxIN3	R3	20	TxIN19	B2
56	TxIN4	R4	22	TxIN20	B3
3	TxIN6	R5	23	TxIN21	B4
4	TxIN7	G0	24	TxIN22	B5
6	TxIN8	G1	27	TxIN24	Hsync
7	TxIN9	G2	28	TxIN25	Vsync
11	TxIN12	G3	30	TxIN26	DE
12	TxIN13	G4	31	TxCLKIN	Clock

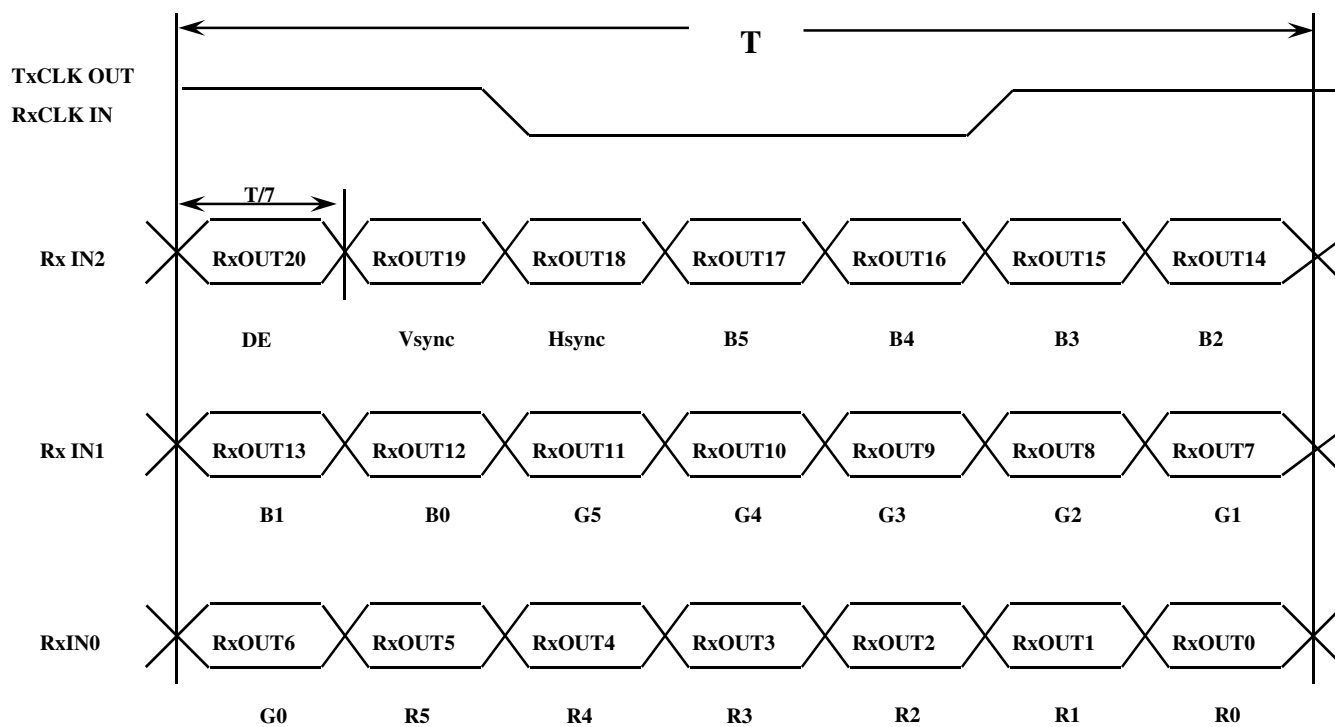
LVDS INTERFACE

Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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5.3 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON



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5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

Color	Display	Data Signal																	Gray Scale Level	
		Red						Green						Blue						
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	45		B5
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	-
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	-
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Gray Scale Of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	Dark	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61
	Light	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R63
Gray Scale Of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	Dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	G1
	↑	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61
	Light	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G63
Gray Scale Of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61
	Light	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

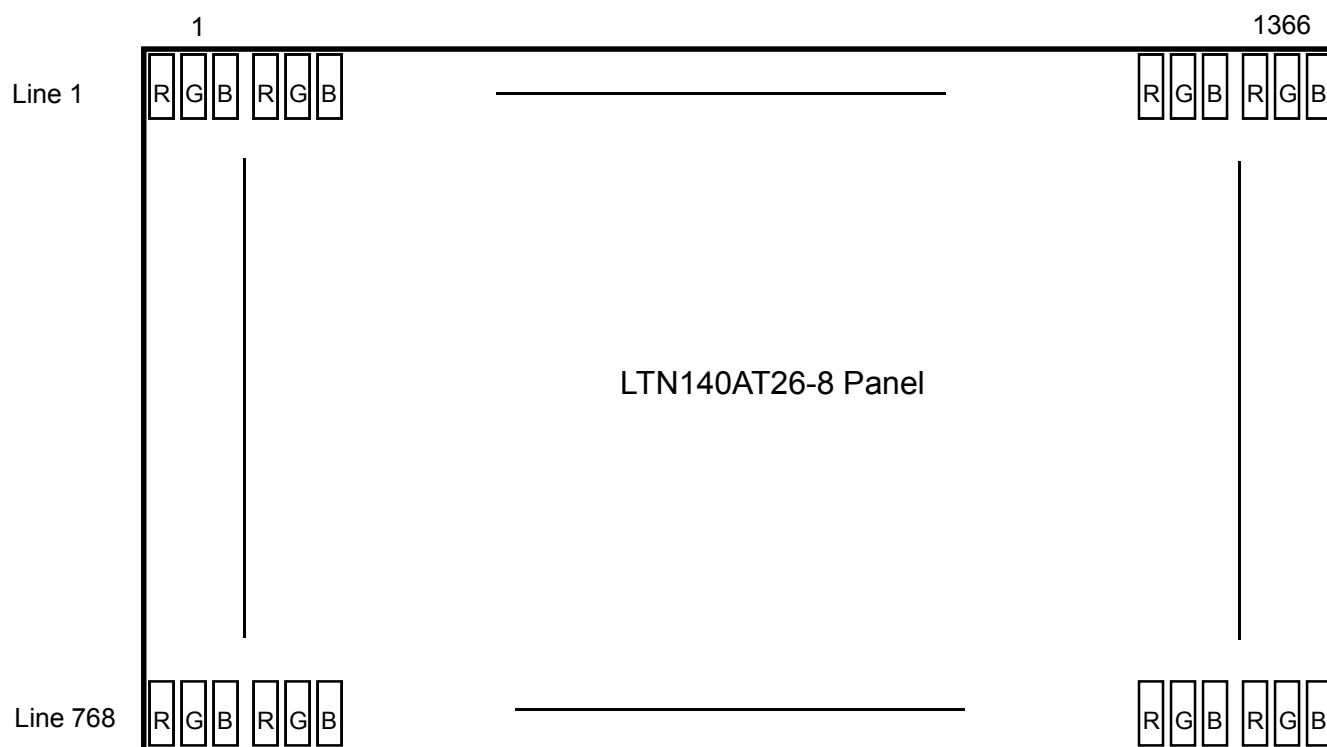
Note 1) Definition of gray :

Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

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5.5 Pixel Format in the display



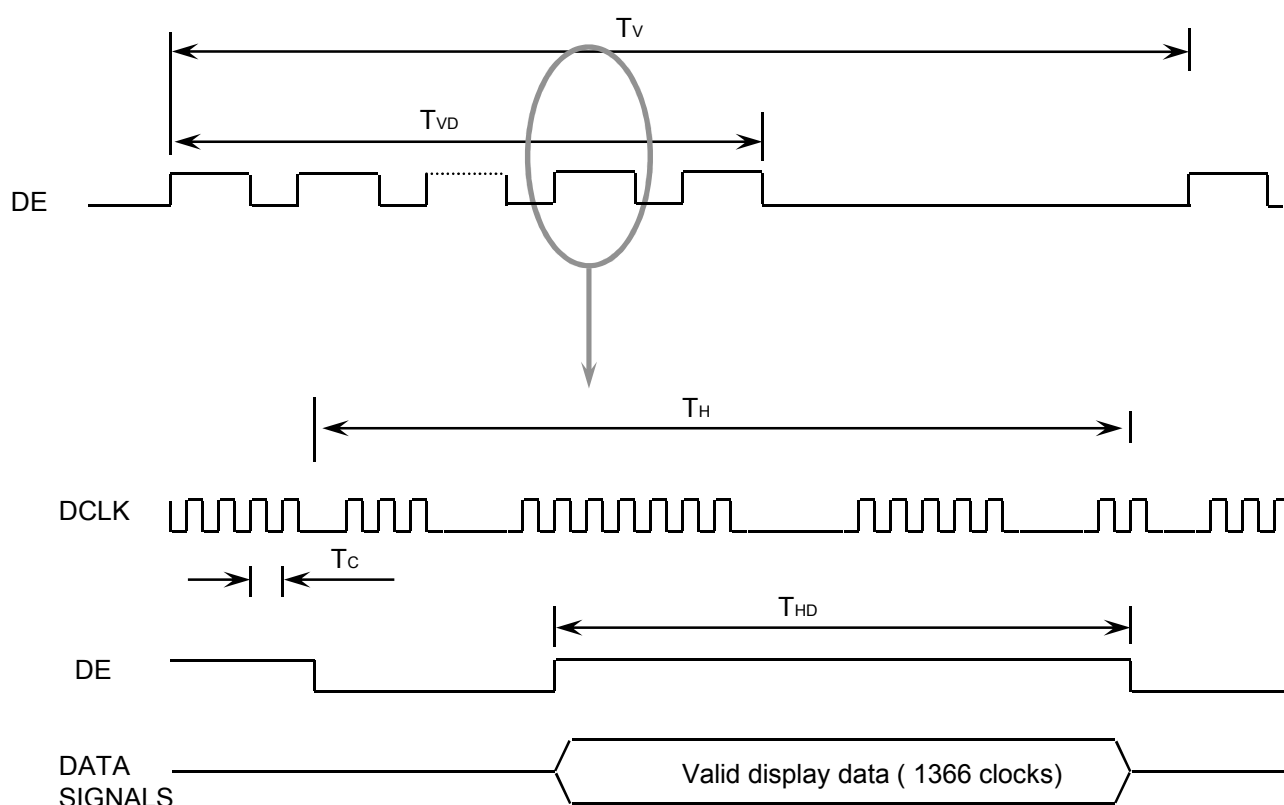
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6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	780	790	980	Lines	
Vertical Active Display Term	Display Period	TVD	-	768	-	Lines	
One Line Scanning Time	Cycle	TH	1440	1526	1800	Clocks	
Horizontal Active Display Term	Display Period	THD	-	1366	-	Clocks	

6.2 Timing diagrams of interface signal

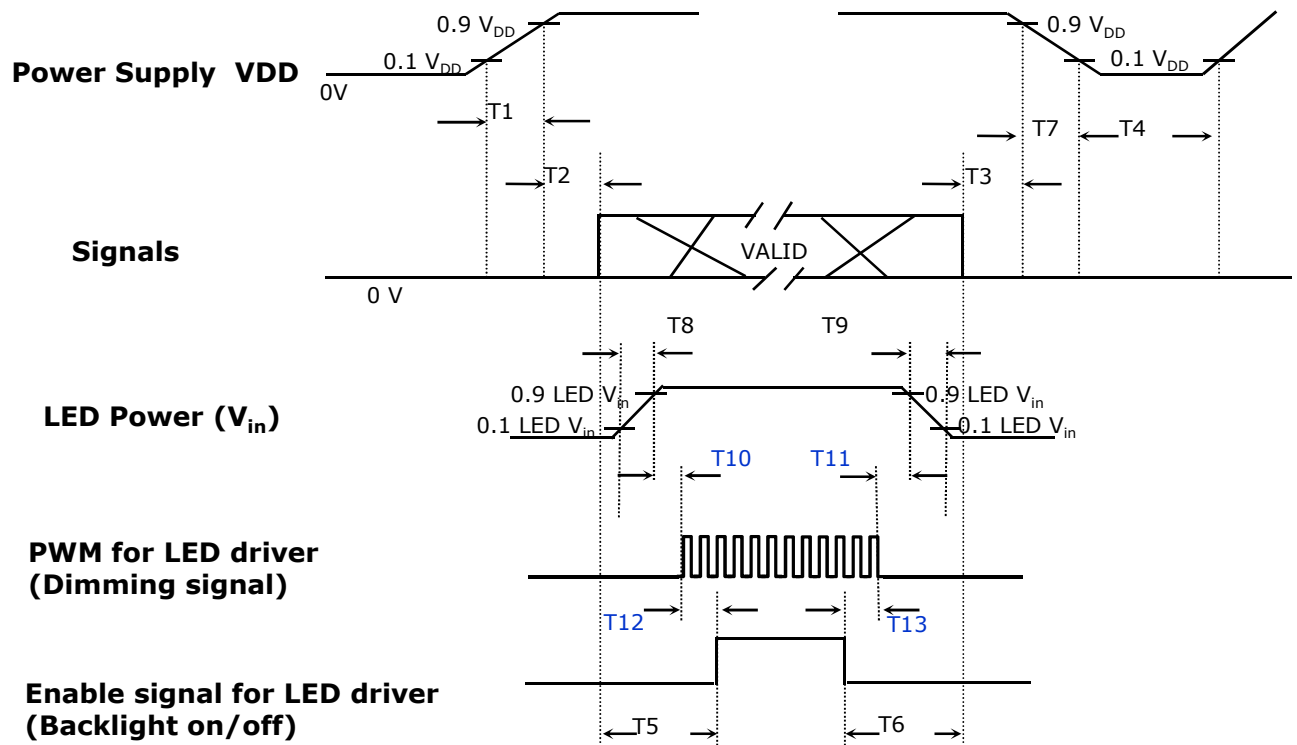


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6.3 Power ON/OFF Sequence

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: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



Power ON/OFF Sequence

Timing (ms)	Remarks
$0.5 < T1 \leq 10$	V _{DD} rising time from 10% to 90%
$0 < T2 \leq 50$	Delay from V _{DD} to valid data at power ON
$0 < T3 \leq 50$	Delay from valid data OFF to V _{DD} OFF at power Off
$500 \leq T4$	V _{DD} OFF time for Windows restart
$200 \leq T5$	Delay from valid data to B/L enable at power ON
$200 \leq T6$	Delay from valid data off to B/L disable at power Off
$0 < T7 \leq 10$	V _{DD} falling time from 90% to 10%
$0.5 < T8 \leq 10$	LED V _{in} rising time from 10% to 90%
$0.5 < T9 \leq 10$	LED V _{in} falling time from 90% to 10%
$0 \leq T10$	Delay from LED driver V _{in} rising time 90% to PWM ON
$0 \leq T11$	Delay from PWM Off to LED driver V _{in} falling time 10%, Must Keep rule
$0 \leq T12$	Delay from PWM ON to B/L Enable ON, Must Keep rule
$0 \leq T13$	Delay from B/L Enable Off to PWM Off

Power Sequence & Timing Parameters

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7. Mechanical Outline Dimension

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Refer to the next page

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This page will be replaced with the outline drawing after producing PDF file.

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8. PACKING

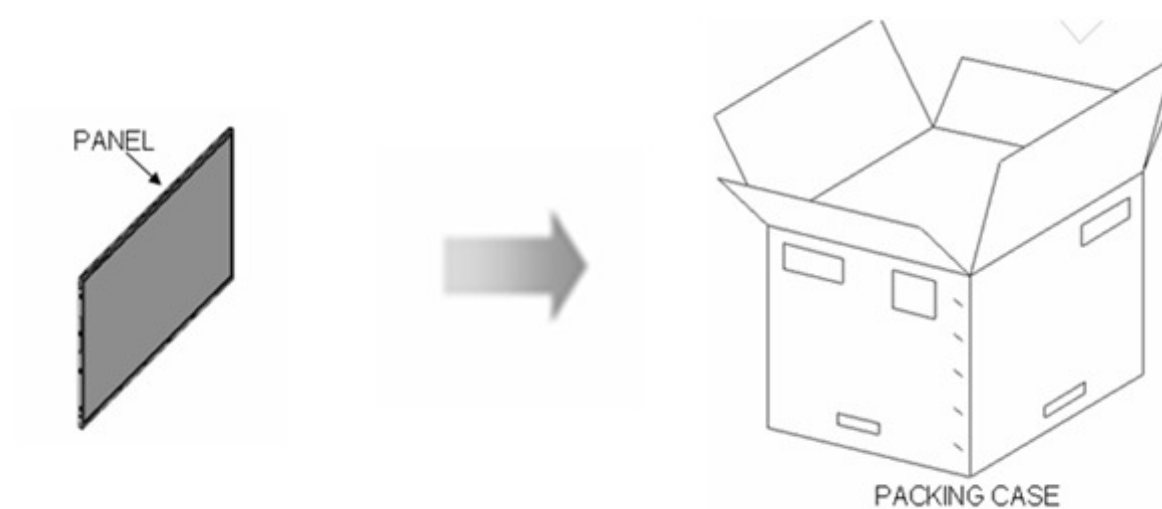
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1. CARTON (Internal Package)

(1) Packing Form

Corrugated Cardboard box and EPS form as shock absorber

(2) Packing Method



Note (1) Total : Approx. 10.7 Kg

(2) Acceptance number of piling : 15 sets

(3) Carton size : 347.5(W) X 375(L) X 246(H)

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(3)Packing Material

No	Part name	Quantity
1	Static electric protective sack	30 pcs
2	Packing case (Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

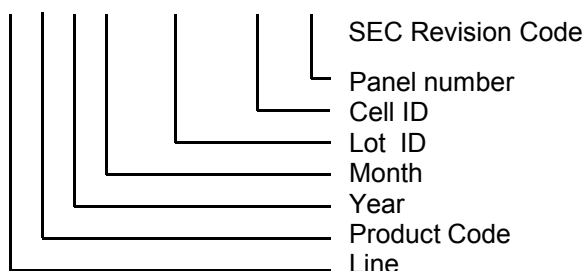
9. MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

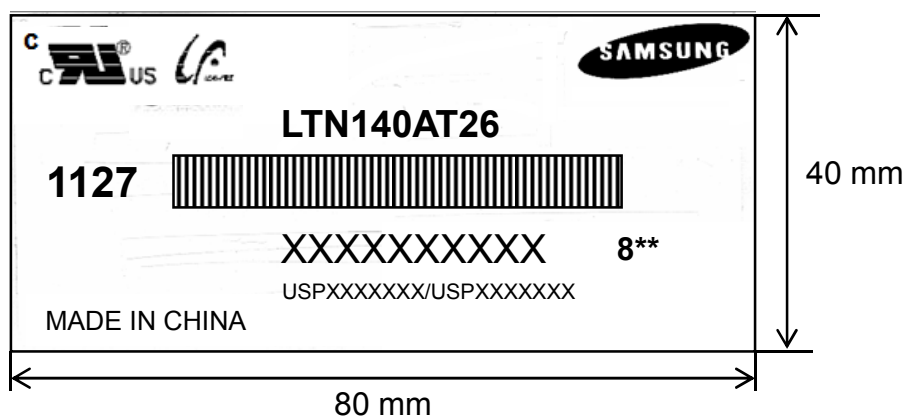
(1)Parts number : LTN140AT26

(2)Revision code : 3 letters

(3)Lot number : X X X X XXX XX X 8**



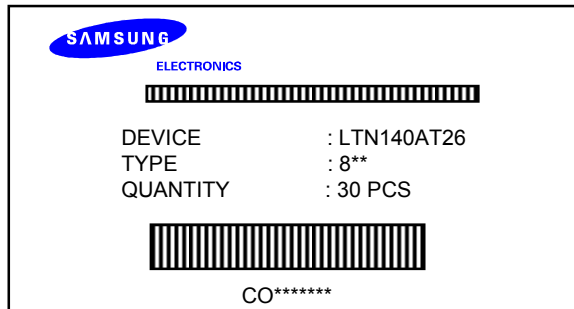
(4) Nameplate Indication



Parts name : LTN140AT26
 Lot number : XXXXXXXXXXXX
 USPXXXXXXXX/USPXXXXXXXX : Related patent Num.
 Inspected work week : 1127 (2011 year, 27th week)
 Product revision Code : 8**

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(5) Packing small box attach

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10. GENERAL PRECAUTIONS

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1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and LED back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA (Isoprophyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static, it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

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2. STORAGE

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ITEM	Unit	Min.	Max.
Storage Temperature	(°C)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	<ul style="list-style-type: none">- The storage room should provide good ventilation and temperature control.- Products should not be placed on the floor, but on the Pallet away from a wall.- Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation.- Avoid other hazardous environment while storing goods.- If products delivered or kept in conditions of over the storage period of 3 months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20°C and a humidity of 50% for 24 hours.		

3. OPERATION

- (a) Do not connect,disconnect the module in the “ Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3 “ Power on/off sequence “.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

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4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on)
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

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